# Crop Residue Burning

# Operating Guide

Idaho Department of Environmental Quality

Draft July 30, 2008

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# ACRONYM LIST

| | |
|---|---|
| agl | above ground level |
| BMA | burn management area |
| CRB | crop residue burning |
| CRD | crop residue disposal |
| DEQ | Department of Environmental Quality |
| ft | feet |
| GIS | geographical information systems |
| GFS | Global Forecast Systems |
| GPS | global positioning system |
| IDL | Idaho Department of Lands |
| ISDA | Idaho State Department of Agriculture |
| MM5 | mesoscale meteorological model |
| m | meter |
| mb | milli-bar |
| mph | miles per hour |
| NAAQS | National Ambient Air Quality Standards |
| NWS | National Weather Service |
| $O_3$ | ozone |
| PBL | planetary boundary layer |
| $PM_{2.5}$ | particulate matter under 2.5 microns in size |
| ppb | parts per billion |
| RH | relative humidity |
| ROA | Regional Office Analyst |
| SBC | Seasonal Burn Coordinator |
| SIP | State Implementation Plan |
| SMA | Smoke Management Analyst |
| $\mu g/m^3$ | micrograms per cubic meter |
| VI | ventilation index |
| WRF | Weather Research and Forecasting Model |

# 1. PURPOSE

The purpose of this operating guide is to serve as the main crop residue burning (CRB) smoke management program implementation tool. This guide describes in detail the overall and day-to-day operation of the program. Since the crop residue burning program is designed to be dynamic, this guide will be reviewed and improved on an annual basis as the Department of Environmental Quality (DEQ) and stakeholders gain expertise through experience and refinement of forecast tools.

This document is meant to be used as a guide and not followed strictly. It is impossible to capture all possible scenarios that might occur. Since this is the first year for the DEQ CRB program, additional information may be added as it is gained from experience.

This operating guide does not apply to crop residue burning on the Indian Reservations in Idaho. For information on field burning on reservations in Idaho, please contact the individual tribes.

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# 2. PROGRAM SUMMARY

The following is a summary of the commitments made during the crop residue disposal (CRD) negotiation process and memorialized in the statute, rule, and state implementation plan (SIP).

### *Grower Requirements*

- Obtain approval from DEQ prior to burning
- Register for permit at least 30 days prior to the proposed burn date, including the following information:
  - Location of the property (field)
  - Plot plan showing the location of each proposed crop residue burning area in relation to the property lines and indicating the distances and directions of the nearest residential, public, and commercial properties, and roads
  - Type, acreage and fuel characteristics of crop residue proposed to be burned
  - Preventative measures available
  - Proposed date of burning
- Pay registration fee of $2 per acre to be burned. Must be submitted 7 days prior to the proposed burn
- Carry a portable form of communication during the burn, burn residue only in the field where it was generated, and report certain information to DEQ after the burn

### *DEQ Requirements*

- Prohibited from approving a burn if it is determined that ambient air quality levels
  - Are exceeding, or are expected to exceed, 75% of any national ambient air quality standard (NAAQS) on any day, and these levels are projected to continue or recur over at least the next 24 hours
  - Have reached, or are forecasted to reach and persist at, 80% of the 1-hour action criteria for particulate matter (currently 80 $\mu g/m^3$ for 1-hour average)
- No burning allowed on weekends, federal or state holidays, after sunset or before sunrise, or during an air stagnation episode or degraded air quality caution.
- Provide near-real-time information on whether a given day is a burn or no burn day, location and number of acres permitted to be burned, meteorological conditions and real time air quality monitoring data.
- Prohibit burning within 3 miles of institutions with sensitive populations when surface wind speeds exceed 12 mph at the field.
- Consider the following parameters when making a burn decision:
  - Expected emissions

  - Proximity and strength of other burns
  - Moisture content of crop residue material
  - Acreage, crop type, and fuel characteristics
  - Meteorological conditions
  - Proximity to institutions with sensitive populations
  - Proximity to public roadways
  - Proximity to airports
  - Any other factors relevant to preventing exceedances of the program concentration limits and/or action levels defined by statute, rule, and/or SIP.
- Develop an annual report that shall include, at a minimum, an analysis of the causes of exceedance of the program defined concentration limits, if any, and an assessment of the circumstances associated with any reported endangerment to human health associated with a burn. The report will also include recommended revisions to the rule or this operating guide deemed necessary to prevent future exceedances of the program concentration limits.
- Assemble an advisory committee consisting of representatives from environmental organizations, tribal organizations, the Idaho State Department of Agriculture (ISDA), DEQ, and others to discuss open burning of crop residue issues.
- Designate burn or no-burn days by county. Post daily on the Web site, and offer an email update service, with the following information:
  - Burn or no-burn day determination
  - Location and number of acres permitted to be burned
  - Meteorological conditions and any real-time ambient air quality monitoring data
  - Toll-free number to receive requests for information
- Develop a process for enhanced documentation of the burn/no burn decision making process/air quality when smoke impacts reach specified levels.
- Develop real-time geographic information systems (GIS) display system of data.
- Track 2-hour rolling average for documentation.

# 3. DEQ BURN SEASON ROLES AND RESPONSIBILITIES

DEQ has no responsibility for fire safety and/or prevention. The grower is responsible for obtaining all other required permits and appropriate fire safety equipment. The person conducting the burn is responsible for the burn until the fire is out. If the fire escapes, the grower can be held liable for any property damages and fire suppression costs. If a burn escapes when DEQ staff are on-site, the DEQ staff shall move themselves and their vehicles to a safe area. DEQ staff will not assist in controlling the fire.

### *Smoke Management Program Coordinator*

- Serve as backup for the state office smoke management analyst
- Assist/support enforcement activities
- Assist/support outreach efforts

### *Smoke Management Analyst (State Office and North Idaho)*

- Review registration forms to determine completeness
- Contact grower if additional information is needed for the registration
- Verify fee receipt with registered fields
- Send the registration and fee approval letters to growers
- Make burn decision for each burn management area (BMA) (burn/no-burn and # acres per BMA)
- Review meteorological forecasting tools
- Review air quality and meteorological data
- Complete assigned fields in checklist
- Review contractor meteorologist's forecast
- Participate in daily conference calls
- Provide support to regional offices
- Inform smoke management program coordinator of issues as necessary
- Assist/support enforcement activities
- Conduct outreach

### *Regional Office Analyst*

- Determine allocation of BMA approved acres (per county and which grower)
- Review air quality and meteorological data

- Complete assigned fields in checklist
- Review contractor's forecast
- Participate in daily conference calls
- Deploy seasonal burn coordinators
- Monitor real-time air quality and meteorological data throughout burn day
- Respond to complaints and questions
- Investigate apparent violations
- Develop enforcement referral package for potential violations
- Assist/support enforcement activities
- Conduct outreach

### *Seasonal Burn Coordinators*

- Participate in daily conference calls (comment on current day's events)
- Notify growers of preliminary and final approvals
- Respond to complaints and questions
- Investigate apparent violations
- Assist in the development of enforcement referral packages
- Observe burns in field
- Document field observations
- Stay in contact with growers throughout burn day
- Have authority to shut down burns if conditions deteriorate
- Assist/support enforcement activities
- Assist/support outreach efforts

### *Contract Meteorologist*

- Provide a burn forecast and recommendation the day before the burn
- Provide an updated burn forecast and recommendation the morning of the burn

### *Database Programmers and Web Developers*

- Maintain and run grower registration database
- Maintain and run grower and public websites

### *GIS Analysts*

- Maintain and run operations online tool

- Run standard daily queries on registration database and distribute calculations to smoke managers, regional and field staff
- Prepare and distribute daily maps to help with burn decisions and field operations
- Support smoke managers by performing specific spatial analyses as needed for burn decision-making

### *Fiscal Staff*

- Collect and record registration fees

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# 4. PRE-BURN SEASON

Before a grower can be approved to burn, they must register, pay fees, and complete State of Idaho CRB training. After all three requirements are met, the grower is eligible for approval to burn.

## 4.1 Grower Training

All growers and burners that intend to burn crop residue must complete a CRB training session provided by DEQ. Past CRB training by the Idaho State Department of Agriculture (ISDA) that occurred within the last five years of your proposed burn date meets this requirement. Refresher training must be completed at least every five years. The training will cover:

- Air Quality Protection and Smoke Management
- New CRB Program
- Registration and CRB Process
- Burn Decision Process
- Burning Techniques/Best Practices

This training will be offered in at least one location in each regional office. The training will also be available online.

## 4.2 Grower Registration and Fee Process

Growers must register their fields at least 30 days prior to the requested burn date. In addition, fees must be paid at least 7 days prior to the requested burn date. Registrations will be accepted online and in paper form. For those growers registering online, a signed copy of the registration form must be mailed to DEQ. The DEQ program office must receive this signed copy of the registration 7 days prior to the proposed burn date. This is the same date that registration fees must be received.

The following information is required for registration:

- Location of the property – township/Range/Section/¼ ¼ section
- Applicant (and person conducting burn) information – name, mailing address, phone number
- Portable form of communication – phone number or radio frequency
- Plot plan
- Type, acreage, and fuel characteristics
- Preventative measures
- Proposed date of burning

Any additional information that would be helpful to DEQ when making a burn decision should also be included on the registration form. This may include special topographical features (canyon rims), special conditions (specific wind direction needed), and/or sensitive populations.

If the grower registers online, they may pay their fees online or by mail. If growers submit only a hardcopy registration form, they must pay fees by mail. At this time, we are only able to accept online fee payment from those who submit the registration form online. If mailed, both fee payments and registration forms are sent to:

Idaho Department of Environmental Quality
CRB Program
Crop Residue Burning Registration
1410 N. Hilton, Boise, ID 83706-1255

## 4.3 DEQ Processing of Registration and Fees

Processing of all registration forms and fees will be done in the State Office by either the program smoke management analyst or a seasonal burn coordinator.

Registration and fee materials will be date stamped and entered into the CRB database, and any fee materials will be forwarded to the Fiscal office. Staff will review the information submitted to determine whether it is accurate and complete. If additional information is needed, DEQ will call the grower to obtain the required information.

Once DEQ has determined that the registration is complete, a "registration approval" letter will be sent to the grower. The purpose of this letter is to verify with the grower that the information they submitted is complete, it has been accepted by the Department, and **registration** requirements have been met. **This is NOT a final approval to burn.** It is a document that includes general burn prescriptions and any site-specific requirements DEQ deems necessary to ensure compliance with the air quality and safety requirements of the Rules. Prescriptions and requirements included in this letter are dependent on the field location and are not expected to change from year to year. Some of the prescriptions may be taken from additional information the grower submits on the registration form (e.g., specific wind direction needed).

Similar to the registration process, a "fee approval" letter will also be sent to the grower when fees have been received. The purpose of the "fee approval" letter is to verify which fields have been paid for and verify that the grower has met the fee payment requirement of the permit by rule. **Again, this is NOT a final approval to burn.**

## 4.4 Burn Season Planning

When DEQ receives a registration and fees, staff will begin to develop prescriptions for fields based on the location of the field in relation to critical areas (e.g., roadways, canyon rims, and sensitive populations).

During the burn season, DEQ staff will query the CRB database for the burn requests for the next week (starting the following Monday). This will enable staff to ensure that growers are ready to burn, to get a feel for the number and distribution of proposed burns, and to sort for specific burn conditions. DEQ staff may contact growers to verify that they are ready to burn the following week.

# 5. BURN SEASON

## 5.1 Burn Decision Process

The smoke management analysts are responsible for making the burn recommendation for each BMA. The burn recommendation is based on the review of meteorology model outputs, local air quality and burn conditions, and the burn forecast provided by the contract meteorologist. This burn recommendation includes a burn/no-burn recommendation and the number of acres approvable if appropriate. A conditional burn recommendation may be used for the preliminary burn decision (i.e., day before) but not the final burn decision. A conditional burn recommendation is used when the forecasting tools don't clearly indicate either a burn or no-burn day. The smoke management analysts' burn forecast focuses on review of pollutant concentrations, meteorological tools, wildland fires, prescribed fires, satellite observations, and the contractor's forecast.

The regional office analysts, with input from the seasonal burn coordinators, will either concur with the burn recommendation or modify it based on local conditions. Once the regional office analysts have concurred or made any modifications to the burn recommendation, the preliminary burn decision is considered final. This preliminary burn decision is made is made by 5:00pm local time the day before the burn. For a Monday burn day, the preliminary burn decision is made by 5:00pm on the Friday before.

A preliminary burn decision of "no-burn" will not be re-evaluated and changed the day of the burn. The final burn decision will remain as a "no-burn."

This process is repeated the morning of the burn using updated forecasts. On the day of the burn, the final burn decision is made by 11:00am.

Once a day is designated as a burn day, or the preliminary burn decision is for a conditional burn day, and the number of acres is approved, the regional office analyst allocates those acres to the counties in the BMA, determines the time of burn, and identifies which growers and fields are approved to burn.

Figure 1 shows this burn decision process in a flow diagram. Appendix B lists the burn decision procedures for both the grower and DEQ.

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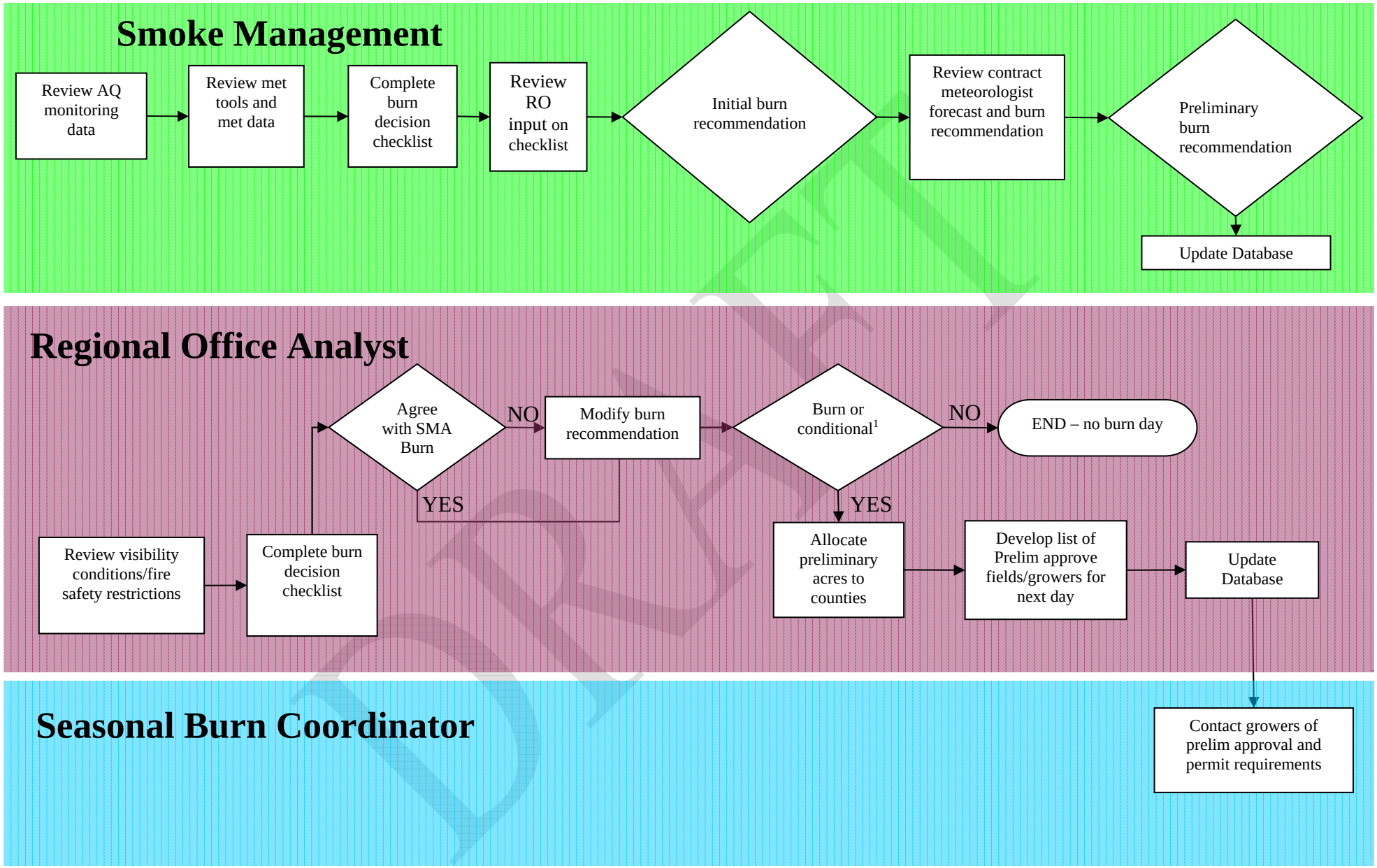


[1] A conditional burn decision will only be used for the preliminary burn decision the day before the burn.

**Figure 1. Burn Decision Process Flow Diagram**

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## 5.2 Burn Decision Criteria and Parameters

DEQ staff will consider a number of parameters and associated factors in order to make a sound decision about whether to allow the burning of crop residue for each individual field. Generally, no single parameter is the basis for the burn/no-burn decision. Rather, some combination of parameters will allow DEQ to ensure the best possible conditions for dispersion of smoke. It must be emphasized that air quality monitoring data may remain in the good range but meteorological forecasts or observed conditions may be such that burning cannot be allowed due to poor dispersion characteristics.

Idaho has diverse topography, climate, soils, and crops. To better address this diversity, DEQ has developed BMAs that divide the state into more manageable parts. Figure 2 shows all the BMAs in the state.

According to the CRB rule, DEQ will consider the following criteria when making a burn decision:

- Expected emissions from all burns proposed on the same day
- The proximity of other burns and other potential emission sources within the area that may be affected by the proposed burn.
- Moisture content of the material to be burned
- Acreage, crop type, and fuel characteristics to be burned
- Meteorological conditions
- Proximity to institutions with sensitive populations**.**
- Proximity to public roadways**.**
- Proximity to airports**.**
- Any other factors relevant to preventing exceedances of the allowable pollutant concentrations, such as burning/ignition method and soil moisture.

### 5.2.1 Air Quality

DEQ will review the air quality monitoring data in each BMA and determine if the ambient air quality levels:

- Do not exceed 75% of the level of any NAAQS on any day and are not projected to exceed such level over the next 24 hours, 75% of the NAAQS correspond to the following concentrations:
  - 26 $\mu g/m^3$ for $PM_{2.5}$ (24-hour average)
  - 56 ppb for Ozone (8-hour average)
  - 112 $\mu g/m^3$ for $PM_{10}$ (24-hour average)
- Have not reached, and are not forecasted to reach and persist at, 80% of the 1-hour action criteria for particulate matter under Section 556 of the Rules

- 64 µg/$m^3$ for $PM_{2.5}$ (1-hour average)

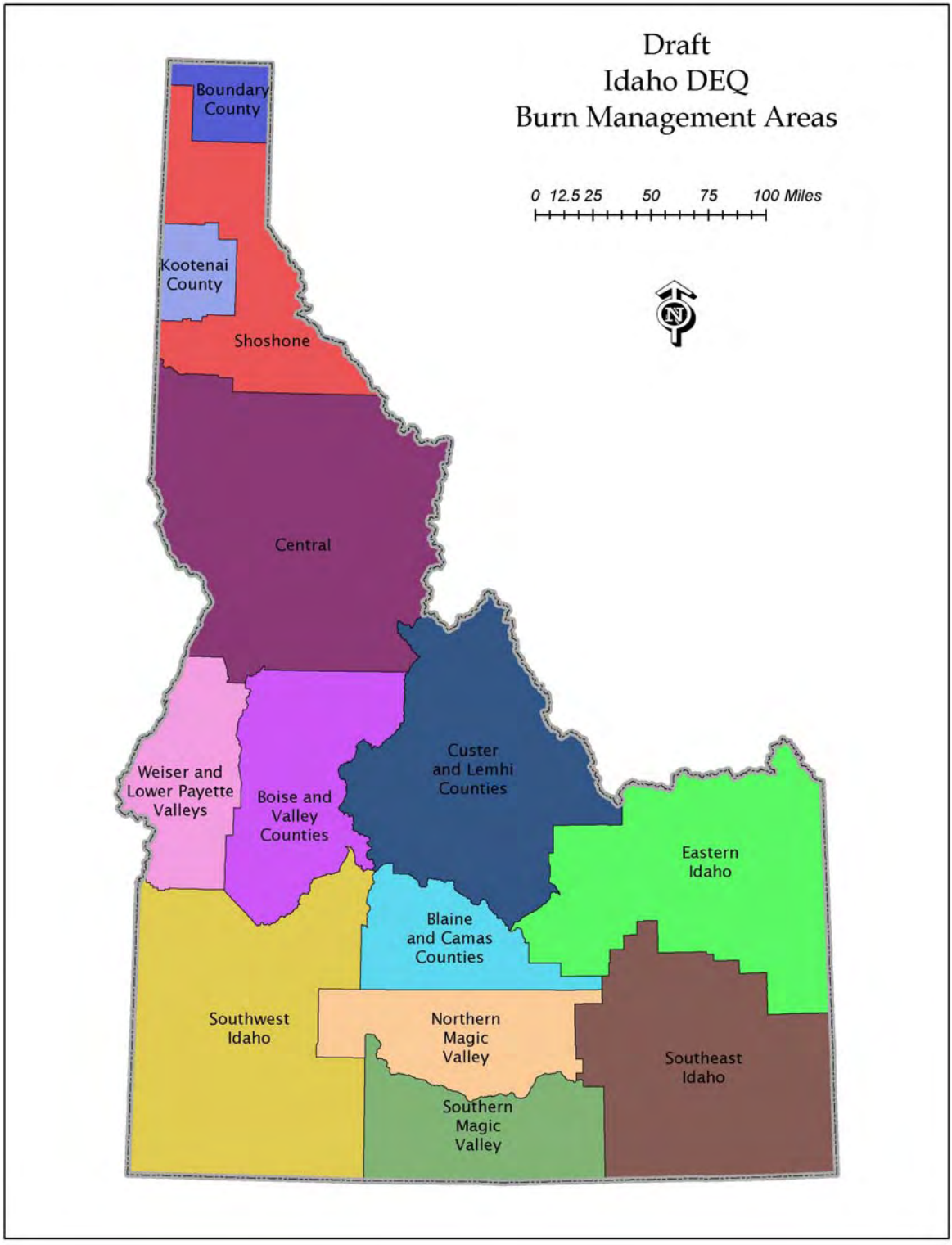


**Figure 2. Burn Management Area Map.**

Visibility conditions will be considered when deciding whether or not to approve burning. When deciding to allow burning on a given day, if visibility is less than 10 miles and is expected to remain so throughout that day, a no-burn decision will be made.

DEQ will not manage the CRB program so as to consistently reach the program concentration limits listed above. Rather, DEQ will use the following general air quality guidelines when making burn decisions.

- For hourly $PM_{2.5}$ concentrations below 15$\mu g/m^3$, burning may be allowed if all other burn parameters discussed below support a burn decision.
- For hourly $PM_{2.5}$ concentrations of 15 $\mu g/m^3$ to 20 $\mu g/m^3$, greater emphasis will be placed on consideration of all other burn parameters listed below.
- Specific burns may be approved when hourly $PM_{2.5}$ concentrations are above 20 $\mu g/m^3$ and below the limits listed above only in very limited circumstances.

These air quality guidelines will be reviewed and updated throughout the burn season as DEQ gains experience in CRB smoke management.

### 5.2.2 Meteorological Data

Table 1 lists the burn decision meteorological parameters that DEQ will review when making a burn decision. The goal is to assure good plume rise and ventilation (smoke rises away from the ground) and good to excellent dispersion (smoke goes into the transport winds and moves out of the area). Aspects of the meteorological data that will be evaluated are indicated in Table 1. The information listed in Table 1 is intended as guidance only and will not be used as absolute requirements.

The information needed to evaluate these parameters is obtained from several sources and most of them are made available to burn coordinators in a condensed format each day. Sources of forecast and observation data include:

- Forecast data from the Weather Research and Forecasting Model (WRF)
- National Weather Service (NWS) forecasts and forecast model products
- Surface weather stations and upper air stations for current conditions

## Table 1. Burn Decision Meteorological Parameters

| Parameter | Burn Day | Conditional Burn Day | No-Burn Day |
|---|---|---|---|
| **Ventilation Index (VI)** (Based on 20m windspeed x PBL height and reported on University of Washington WRF graphics) | "Good" ventilation is preferred, however if VI is "Good" or "Excellent", check to make sure surface windspeeds are <12mph. | • "Good" to "Excellent" Ventilation may be unacceptable if surface winds are > 12mph<br>• Burning under a "Marginal" VI may be acceptable only if other criteria are met and burning proceeds with caution.<br>• "Poor" Ventilation should be avoided unless there is good vertical convection with enough fuel and/or wind to carry the fire and good transport winds aloft. | "Very Poor" ventilation should be avoided. |
| **Cloud cover** | Mostly sunny to partly cloudy (0.1 to 0.4) is typically best. | • Clear bright skies may indicate a high pressure system with stagnant conditions. Make sure other criteria are met if this is the case.<br>• Cloudy conditions may be acceptable if clouds are high and all other criteria are met. | Mostly cloudy conditions, with low clouds (7/8 or higher) should be avoided. |
| **Surface wind speed (sustained)** | Moderate winds, 3 to 8 mph are preferred. | • Calm or near calm winds should be avoided Light winds < 3 mph generally are insufficient to carry the fire. However, sunshine and abundant/dry fuel, especially on a hill, may result in good rise for lighter winds < 3 mph.<br>• Winds 8 – 12 mph may be ok if there is strong sunshine to maximize vertical convection, but proceed with caution. | • Winds >12 mph are prohibited within 3 miles of an institution with sensitive population.<br>• Winds > 15 mph should be avoided even in remote areas for fire safety reasons. |
| **Surface wind direction** | • To avoid institutions with sensitive populations, populated areas and nearby roadways, etc.<br>• If possible, also avoid large bodies of water and large canyons/valleys.<br>• Be aware of typical wind shifting patterns in your area and atypical forecasted wind shifts. | | It is critical to avoid cities and institutions with sensitive populations. |
| **Transport wind speed** (at 850mb level or about 5000 ft) | 7 – 20 mph is preferred | Use caution with transport winds > 20 mph | Upwind of cities and institutions with sensitive populations, transport winds > 20 mph should be avoided. |
| **Transport wind direction** | To avoid institutions with sensitive populations, populated areas and nearby roadways, airports, etc. | If possible, also avoid large bodies of water and large canyons/valleys, particularly if the mixing height is < 5000ft. | It is most critical to avoid cities and institutions with sensitive populations at all times. |

| Parameter | Burn Day | Conditional Burn Day | No-Burn Day |
|---|---|---|---|
| **Mixing Height** | Greater than 5000ft agl is desired | With mixing heights of 3000 ft – 5000ft, caution should be used. | Avoid if the mixing height is < 1000 ft agl |
| **Relative Humidity (RH)** | 18 – 25% RH is the ideal range | • RH < 20% is acceptable if fire control/safety concerns with surrounding fuels are low.<br>• For Bluegrass, RH > 30% may inhibit plume rise and smoke dispersal. | RH > 35% will be avoided as it may inhibit smoke dispersal and may leave unburned materials. |
| **Inversion Conditions**<br>Inversion conditions are indicated by a lapse rate on the skew-T curve that is steeper than the adiabatic lapse rate.<br>A strong inversion in indicated by a vertical or negative temperature gradient (sloping to the right) and should be observable in the skew-T diagram of altitude vs. temperature.<br>There are two types of inversions and they should both be avoided. | Preferably burns should occur after 10 am and before 4pm (fire out) to avoid trapping the smoke in mountain valleys by radiation inversions. | Radiation Inversions. This is a surface based inversion that exists on most mornings and evenings particularly when daytime heating is strong.<br>• Burning should not be permitted before the inversion has mixed out unless transport conditions after breakup would best protect population centers and burning during an inversion does not cause adverse impacts.<br>• A sufficient amount of time should be allowed at the end of the burn day for any residual smoke to leave the area before a radiation inversion returns. | Subsidence Inversions. When a strong high pressure system is present, with clear skies, hot air subsides causing stable air and poor dispersion. This is easy to forecast and a *No Burn* day should be called when a strong high pressure system is over the region. |

### 5.2.3 Other Relevant Factors

When making a burn decision, DEQ must also review factors relevant to preventing exceedances of the program concentration limits listed in Section 5.2.1. The following is an example of other factors that may be reviewed:

- Burning method refers to the lighting method such as match/lighter, propane torch, or diesel burners, as well as the pattern of lighting. Generally, the hotter the fire, the less smoke it produces, and the better the smoke rises for dispersion.
- Fuel type, size, and arrangement affect smoke generation and dispersion. Generally, the more dense the fuel, the more smoke it produces when it burns. For example, fuel density can change with crop type and variety (e.g., generally, wheat stubble is less dense than bluegrass stubble and certain wheat or bluegrass varieties can be denser than others).
- Fuel loading/expected emissions. Fuel loading is the amount of residue that is available to be burn per acre. This is a function of fuel type, acreage of the burn, density of material remaining in the field, and burn type. Generally, the greater the fuel loading, the greater the expected emissions and the potential for smoke.
- Fuel moisture is dependent upon fuel type and RH. In general, fuel moisture should be as dry as possible throughout the residue layer to promote plume rise. Fuel moisture influences smoke quantity and plume rise. In general, the greater the fuel moisture, the more smoke and poorer plume rise.

## 5.3 How to Make a Burn Decision

This section lists the general steps that DEQ will follow when making a burn decision.

### 5.3.1 Smoke Management Analyst Burn Recommendation

1. Review the pollutant monitoring data and compare to the program pollutant concentrations and air quality guidelines included in Section 5.2.1 above.
2. Review the NWS forecast and forecast model parameter values by reviewing the forecast skew-T diagram and meteograms. Forecast data is primarily obtained from the WRF-GFS simulation at the University of Washington, however other meteorological forecast products are available to use. Refer to Table 1 for evaluating the meteorological data and tools.
3. Review the daily notes (visibility conditions, wildland fires, fire safety restrictions and fire weather watches and warnings, prescribed fires, satellite observations).
4. Make an initial burn recommendation for each BMA, based on the information above and in Table 2.
    a. A preliminary burn recommendation includes the following:
        i. Burn, no-burn, or conditional recommendation
        ii. For burn or conditional recommendation, the number of acres approved
    b. A final burn recommendations includes the following:

iii. Burn, no-burn recommendation

iv. For burn recommendation, the number of acres approved

5. Review the contract meteorologist's daily burn recommendations for each BMA. These burn recommendations are qualitative assessments based on the smoke dispersion forecast. The contract meteorologist's burn recommendations will be provided as follows:
   a. No Burn –the smoke dispersion forecast is poor. No burning, not even test burns, are recommended.
   b. Conditional –The smoke dispersion forecast is marginal. Limited burning with caution is possible.
   c. Burn – the smoke dispersion forecast is good to excellent
6. Make the preliminary burn recommendation for each BMA.

**Table 2. Acres per BMA guidelines**

| Region | Maximum acreage limits | | |
|---|---|---|---|
| | No Burn | Conditional | Burn |
| Boundary County | 0 | 600 | 3000 |
| Clearwater Airshed | 0 | | |
| Camas Prairie | | 2500 | 6000 |
| North Palouse | | 500 | 1000 |
| South Palouse | | 500 | 1000 |
| Rathdrum Prairie Airshed | 0 | 500 | 2000 |

### 5.3.2 Regional Office Analyst Concurrence

Once the smoke management analyst has made the burn recommendation, the regional office analyst must either concur with the recommendation or discuss modifying the recommendation with the smoke management analyst. In order concur or not, the regional office analyst must review the following at a minimum: the NWS forecast discussion for their burn management areas, the contract meteorologist's forecast, and the burn checklist.

Air quality will be evaluated for each BMA. These analyses may result in burning being allowed in some areas and not being allowed in others, based on the burn parameters and air quality factors for the areas.

### 5.3.3 Determine Which Fields to Approve

The GIS Analyst will provide a calculation of the approved burns for each county in a table with summed acreages.

The following factors are important when determining which fields to approve for a given burn day:

- Burning Near/Along Canyon Rims should be done when both transport and surface winds are blowing away from the canyon.
    - Ensure adequate plume rise will occur. In some cases a test burn may be necessary. Smoke that travels over the canyon while the temperatures in the canyon are relatively cooler than those elsewhere, will drop.
    - For fire safety reasons, burns should be conducted before surface wind speed increases (typically by 12:00PM). Avoid burning if 'whirlwinds' are visible.
- Over larger bodies of water, the atmosphere will typically be cooler and more stable. This can cause 'lake-breezes' in the afternoon that will pull smoke downward - winds at the surface blow from the lake to shore, which causes air above the lake to sink downward. Even in the absence of a true lake-breeze, the interaction between lake-generated winds and prevailing winds is complex and can cause variable conditions that can change quickly. Knowledge of the expected prevailing wind direction and strength is important. It is also important to know the direction of transport winds aloft. They may transport smoke over the lake. Surface and transport winds can be from vastly different directions. A good guide would be to burn downwind of major lakes (so that the smoke never gets a chance to blow over the lake).
- Favorable Winds. Certain areas have fairly predictable daily wind shifts. In such areas, burns should be timed to match favorable dispersion characteristics.
- Burn location is identified on the permit at the township/range/section/¼ ¼ section level .
- Elevation and aspect are also considered. Due to microclimatic variations in wind speed, direction, lift, and dispersion, burn location information is very important.

## 5.4 Required Documentation

### 5.4.1 Burn Decision Checklist

The burn decision checklist will be used to document the burn decision process. This checklist documents the MM5 data, national weather service forecasts, pollutant and meteorological monitoring data, and other factors such as visibility conditions and other fires or smoke in the area. A good portion of the information in the checklist, the MM5 data and the pollutant and meteorological data, is "auto-populated."

### 5.4.2 Yellow Sheet/Red Sheet

DEQ will use a yellow sheet/red sheet process based on the State of Washington's Agricultural Smoke Program. The purpose of this process is to provide additional documentation of events when elevated smoke impacts from approved burns occur based on observed monitoring information.

The yellow sheet has a lower trigger level and must be completed if that level is reached as a result of burning and additional burning is planned. It must include an explanation justifying that additional burning is not expected to result in a further, significant reduction of air quality.

**The red sheet is required when significant impacts are detected and will include details regarding actual approved burning, review of monitoring data, a listing of other potential sources, a summary of dispersion and meteorology, special or unanticipated events or circumstances, and a summary explanation of the situation.**

At this time, DEQ will use the following guidelines for determining when a yellow sheet and red sheet are required. If these levels are reached, a requirement for additional analysis and documentation of the burn outcome is initiated.

**Table 3. $PM_{2.5}$ Trigger Levels for Extra Documentation**

| | 24-HOUR AVERAGE | 2-HOUR AVERAGE |
|---|---|---|
| Yellow sheet | ≥ 16 μg/m$^3$ | ≥ 22 μg/m$^3$ |
| Red sheet | | ≥ 32 μg/m$^3$ |

## 5.5 Permit-by-Rule

The permit-by-rule consists of three parts: registration, fee, and written burn approval.

The grower will receive the following documents during the burn season:

- Registration approval document – acknowledges receipt of registration and information.
- Fee approval letter – acknowledges receipt of fees and documents which fields the fees apply to.
- Written burn approval – final written approval on the Web site the day of the burn.

**THE WRITTEN BURN APPROVAL IS THE ONLY DOCUMENT THAT AUTHORIZES THE GROWER TO BURN THE CROP RESIDUE.**

### 5.5.1 Process to Issue a Permit

The grower will be notified with the preliminary approval for the proposed burn at least 12 hours in advance of the burn. The seasonal burn coordinator will notify the grower of the final approval the morning of the burn. These preliminary and final approvals will be posted on DEQ's Web site with any special requirements under which the burn is approved.

## 5.6 Public Notification

DEQ will notify the public of approved burns in a variety of ways. DEQ is required to post on its Web site for each county:

- Whether a given day is a burn or no-burn day.
- The location and number of acres permitted to be burned.
- Meteorological conditions and any other real-time ambient air quality monitoring data

DEQ also has a toll-free phone number, posted on the Web site that the public can use to receive burn decision information, provide a comment, or submit a complaint. This toll-free number is shared with the Nez Perce Tribe and the Coeur d'Alene Tribe.

## 5.7 Complaint Response and Compliance Procedures

It is the responsibility of the Regional Offices to respond to all crop residue burning complaints, investigate all apparent crop residue burning violations, and refer all apparent crop residue burning violations to the State Program Office for formal enforcement consideration.

In order to maintain consistency with the application of the CRB Program throughout the state and to ensure compliance with the applicable state rules, Regional Office staff will respond to all crop residue burning complaints in the following manner:

- Respond to all crop residue burning complaints as soon as practicable; ideally, this will be within 24 hours after receiving the complaint.
- Log all complaint investigations into the DEQ complaint log system.
- DEQ personnel will document, as appropriate, information pertaining to the complaint. This could include, but is not limited to, the following: law enforcement reports, physical evidence, photos, GPS locations, field descriptions, etc.
- When an apparent crop residue burning violation is observed, the regional office analyst will identify, verify, and secure to the best of their ability, the information necessary to support enforcement activities.

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# 6. PROGRAM EVALUATION AND ANNUAL REVIEW PROCEDURES

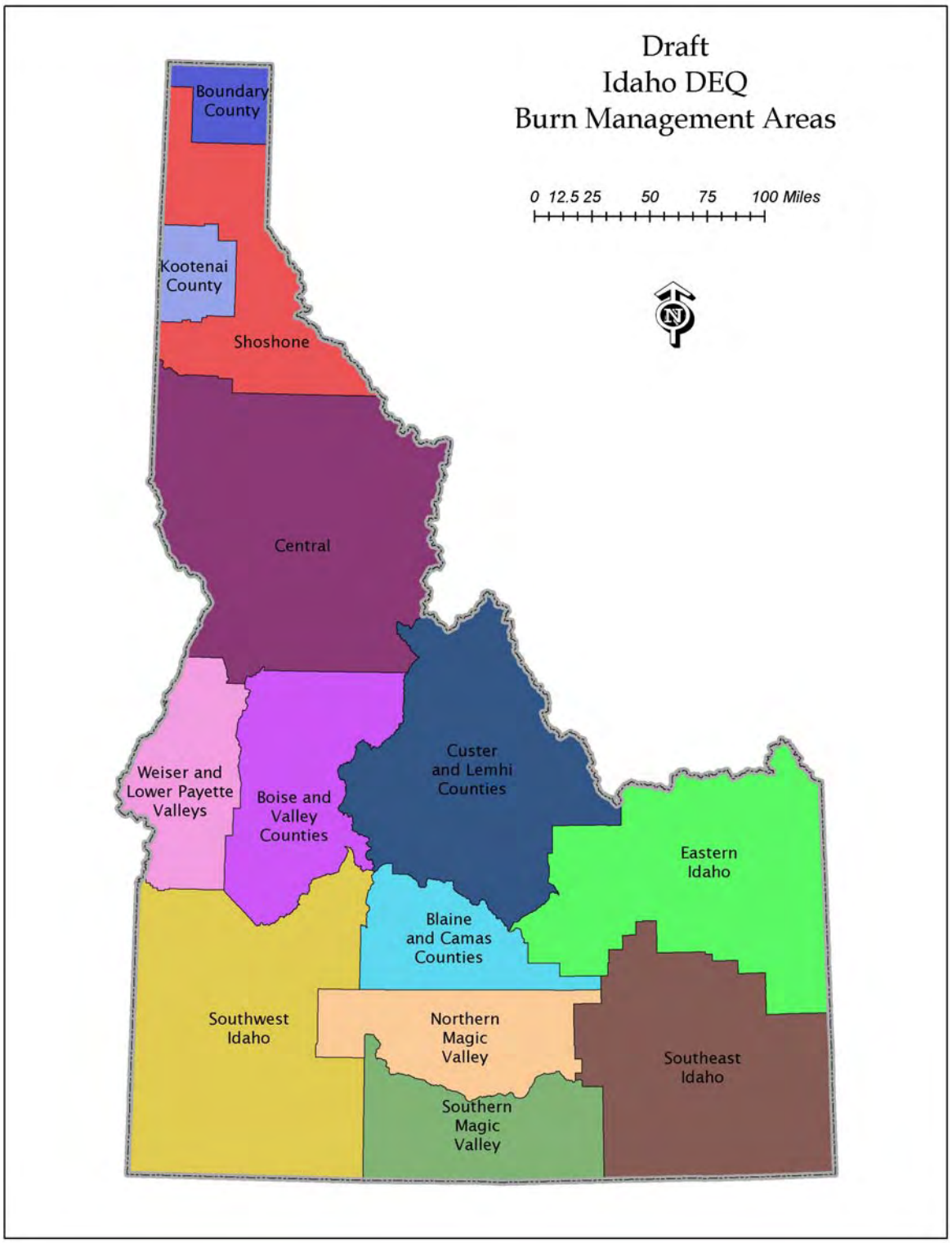
DEQ will review the CRB program and this operating guide annually. DEQ staff review air quality and burn decision data to determine the efficacy of the program. Following are examples of items that will be evaluated annually:

- Data for days with elevated $PM_{2.5}$ levels will be scrutinized to determine causal relationships between any burns conducted, presence of wildland fires, and meteorology.
- Approved burn days with low $PM_{2.5}$ levels will also be analyzed to determine which parameters contributed to that day's smoke dispersion characteristics.

Feedback will be sought from the public, participating burners, EPA, fire districts, tribes, and other smoke management agencies.

Although the program will undergo this thorough annual review, DEQ Air Quality Program staff are also constantly learning. Burns are continuously monitored throughout the day to determine how well they are going and, if any changes occur, why they have occurred. This information will feed back into any adjustments staff need to make in decision-making for subsequent burn days.

# APPENDIX A. Burn Management Area Map



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# APPENDIX B. Burn Decision Procedures

## Grower Responsibilities and Procedures – For Approved Burns

### Prior to Ignition

The grower must obtain other required burn permits such as

- Idaho Department of Lands (IDL)
- Fire Safety permits may be required of all burners between May 10th and October 20th. Growers can obtains fire safety permits from the local fire district office.

### Day Before Burn

1. Approved growers will receive a preliminary burn decision from a seasonal burn coordinator by 5:00 pm local time prior to the day of the approved burn. The grower should be prepared to confirm the following information:
   a. Name and contact phone number
   b. Field location (township, range, section, ¼ ¼ section)
   c. Number of acres to be burned and the crop type
   d. Other pertinent information the office staff or Seasonal Burn Coordinators should know about (e.g. canyon rim, near roadway, near a town, near airport, proximity to institutions with sensitive populations, etc.).

### Day of Burn

1. The Seasonal Burn Coordinator will contact the approved grower by 11:00am for final burn approval confirmation.
2. The grower **MUST** contact the Seasonal Burn Coordinator if the conditions at the field fail to meet the conditions specified in the notice of approval to burn.
3. The grower may be required, as part of the burn approval, to conduct a test burn. Growers are responsible for conducting test burns, especially near sensitive areas (canyon rims, near towns), and must have flaggers stationed for burns affecting roadways. **Test burns will not be used within 3 miles of institutions with sensitive populations.**
   **a. The Seasonal Burn Coordinators will work with growers to identify possible test burn fields.**
   **b. Generally, a test burn will be less than 100 acres in size.**
4. The grower **MUST** be reachable via phone or other pre-determined portable form of communication during the burn.
5. The grower is responsible for shutting down burns when necessary and/or required to do so by the Seasonal Burn Coordinators.

a. If DEQ determines that the burn is having, or will have, an adverse impact on institutions with sensitive populations, DEQ will require the grower to immediately extinguish the fire or withhold additional material such that the fire burns down.

b. Under no circumstances shall more fuel be added.

### Day After the Burn

1. The grower **MUST** provide a post-burn report within 24 hours of burning, or risk losing priority for their next burn. This report must be submitted either using the on-line tool or using the hard-copy form. The following information is required for the post-burn report:
   a. Grower name
   b. Permit #
   c. Burn date
   d. Time burn ignited
   e. Time burn out
   f. Actual location of burn
   g. Actual # of acres burned
   h. Is your burning for the permit # complete for this year?
   i. Residue characteristics at time of burn
   j. Surface wind speed and direction at time of ignition
   k. Grower feedback on how program was effective/ineffective
2. If the grower does not burn the approved field at all, he must contact the Seasonal Burn Coordinator to ensure they are placed back on the burn roster, if desired.

## Smoke Management Analyst (North Idaho and State Office)

Throughout this process, the burn decision checklist shall be filled out accordingly. The Smoke Management Analysts and the Regional Office Analyst are responsible for completing the burn decision checklist. The Regional Office Analysts and Smoke Management Analysts are responsible ensuring the completion of the yellow and red sheets.

### Day Before Burn

1. Review current $PM_{2.5}$ and Ozone monitor readings and trends within the BMA.
   a. Current, 1-hour, 2 hr and 24-hour PM 2.5 average concentrations
   b. Current 2-hr, and 8-hr ozone concentration (if applicable).

   **Compare to the regulations – 75% of any NAAQS and 80% of the 1-hour trigger for particulate matter. A no-burn decision may be made at this point and the following steps will not be needed.**
   - 26 $\mu g/m^3$ for $PM_{2.5}$ (24-hour average)
   - 56 ppb for Ozone (8-hour average)
   - 112 $\mu g/m^3$ for $PM_{10}$ (24-hour average)
   - 64 $\mu g/m^3$ for $PM_{2.5}$ (1-hour average)
2. Review the meteorological forecast models, tools, and real-time data included in Appendix C.
   a. Read NWS forecast discussion
   b. Review meteorological monitoring data – validate met models
   c. Review the Skew-T from MM5 (pseudo-sounding)
   d. Review Meteograms from MM5
   e. Review the MM5 data on checklist
   f. Review satellite observations
   g. Review proposed acres per BMA and maps
3. Review wildland fire and prescribed burn information using a combination of the tools in Appendix D.
4. Make and initial preliminary burn recommendation (burn/no-burn/conditional and # acres) for each BMA based on the information and tools reviewed.
5. Thoroughly review the burn forecast from the contract meteorologist, available by 2:45pm local time. Make note of the burn recommendation on the checklist.
6. Participate on the conference call with the contract meteorologist, Regional Office Analyst(s), Seasonal Burn Coordinators, and any other smoke management programs– 3:30 pm local time. **This conference call includes a summary of observations of current day's burns by the Seasonal Burn Coordinators,** forecasting tools, air quality readings, and meteorologist's recommendation for burning the following day.

7. Make preliminary burn recommendation (burn/no-burn/conditional and # acres) for each BMA.

## Day of Burn

**Update the burn decision checklist with updated information and data.**

1. In making the final burn recommendation, review the preliminary 'Burn decision checklist,' preliminary burn approvals and preliminary burn recommendation.
2. Complete the appropriate portions of the 'Burn decision checklist' for the Final Burn Decision by reviewing the following:
   a. Review the current pollutant monitoring data
   b. Review the meteorological forecast models, tools, and real-time data
   c. Review wildfire and prescribed burn information using a combination of the resources and/or websites in Appendix D.
3. Make the initial final burn recommendation (burn/no-burn and # acres) on the Burn decision checklist based on information and tools reviewed.
4. Thoroughly review forecast from contract meteorologist – available by 7:45am local time. Make note of the burn recommendation on the checklist.
5. Participate on the conference call with the contract meteorologist, Regional Office Analyst(s), Seasonal Burn Coordinators, and any other smoke management programs– 8:30 am local time.
6. Make the final burn recommendation (burn or no-burn and number of acres) per BMA.
7. Throughout the burn day, monitor the air quality and meteorological conditions. If air quality conditions result in the burn decision being changed during the day, proper documentation should be maintained to support decisions to increase or decrease the acres to be burned. If the burn decision changes, coordinate with the Regional Office Analysts to document the change the following tasks must be completed:
   a. Thoroughly document the reasons and conditions supporting the change.
   b. Ensure all CRB staff are updated.
   c. Continue to monitor air quality conditions.

## Regional Office Analysts

Throughout this process, the applicable fields of the burn decision checklist shall be filled out. The Smoke Management Analysts and the Regional Office Analysts are responsible for completing the burn decision checklist. The Regional Office Analysts and Smoke Management Analysts are responsible ensuring the completion of the yellow and red sheets.

### Day Before Burn

1. Review the pollutant and meteorological real-time monitoring data

   **Compare to the regulations – 75% of any NAAQS and 80% of the 1-hour trigger for particulate matter. A no-burn decision may be made at this point and the following steps will not be needed.**

   - 26 µg/$m^3$ for $PM_{2.5}$ (24-hour average)
   - 56 ppb for Ozone (8-hour average)
   - 112 µg/$m^3$ for $PM_{10}$ (24-hour average)
   - 64 µg/$m^3$ for $PM_{2.5}$ (1-hour average)
2. Document the visibility conditions and any fire safety restrictions on the burn decision checklist
3. Thoroughly review the forecast from the contract meteorologist, available by 2:45pm local time. At a minimum, also review the completed burn decision checklist and the NWS forecast discussion.
4. Participate on the conference call with the contract meteorologist, Smoke Management Analyst, Regional Office Analyst, Seasonal Burn Coordinators, and any other smoke management programs in the afternoon.
5. Either concur or modify the preliminary burn recommendation from the smoke management analyst. This concurrence or modification results in the preliminary burn decision.
6. If the preliminary burn decision is for a burn or conditional day, with the input from the Seasonal Burn Coordinators, determine which growers and fields are preliminarily approved to burn the next day.
   a. Approval priority will be as follows:
      i. Favorable conditions for sensitive areas (i.e. fields near towns, roads, canyons) and institutions with sensitive populations
      ii. The forecasted conditions favor the requirements and prescriptions of the area to be burned
      iii. The earliest burn requests received from growers.
   b. The preliminary burn approval is made by 5:00PM.

## Day of Burn

1. Review the pollutant and meteorological monitoring data. Review and document visibility conditions and fire safety restrictions on the burn decision checklist
2. Document the visibility conditions and any fire safety restrictions on the burn decision checklist
3. Thoroughly review the forecast from the contract meteorologist, available by 7:45pm local time. At a minimum, also review the completed burn decision checklist and the NWS forecast discussion.
4. Participate on the conference call with the contract meteorologist, Smoke Management Analyst, Regional Office Analyst, Seasonal Burn Coordinators, and any other smoke management programs in the afternoon.
5. Either concur or modify the final burn recommendation from the smoke management analyst. This concurrence or modification results in the final burn decision.
6. Make the final burn decision (burn/no-burn) by 11:00am local time and document on the checklist. Determine if the preliminary burn approval list needs to be changed. Notify the seasonal burn coordinators of the final burn decision and distribute burn list and maps.
7. Monitor the air quality and meteorological conditions throughout the day.
8. When air quality conditions result in the burn decision being changed during the day, proper documentation should be maintained to support decisions to increase or decrease the acres to be burned. If the burn decision changes, the following tasks must be completed:
   a. Thoroughly document the reasons and conditions supporting the change.
   b. Inform the smoke management analyst staff and the Seasonal Burn Coordinators of the updated burn decision.
   c. Continue to monitor air quality conditions.

## Seasonal Burn Coordinators

### Day Before Burn

1. Review the contract meteorologist forecast.
2. Participate in conference call with meteorological contractor. Be prepared to provide an observation of the current day's completed burns.
3. Receive the preliminary burn decision and the approved grower list and maps for the following day from the Regional Office Analyst.
4. Contact the approved grower(s) to notify him/her of his/her preliminary approval.
5. Supply the burner with the following information (using a pre-defined script, reading certain information from permit?):
   a. Approved burn window or ignition time
   b. Approved burn location(s) or field number(s) (if grower has multiple field requested to be burned)
   c. Specific permit requirements (prescriptions) for the burn (i.e. expected wind direction or speed, potential for rain, etc.)
   d. Other important information
6. Receive assignment for the next burn day from the regional office analyst.

### Day of Burn

1. Review the contract meteorologist forecast.
2. Participate in conference call with meteorological contractor.
3. Receive the final burn decision and the approved grower list and maps for the day from the Regional Office Analyst.
4. Contact the approved grower(s) to notify him/her of his/her final approval.
5. Supply the burner with the following information (using a pre-defined script):
   a. Approved burn window or ignition time
   b. Approved burn location(s) or field number(s) (if grower has multiple field requested to be burned)
   c. Specific permit requirements (prescriptions) for the burn (i.e. expected wind direction or speed, potential for rain, etc.)
   d. Other important information
6. The grower is required to repeat back the permit prescription terms and conditions to ensure understanding.

7. Receive any updated instructions for the day from the Regional Office Analyst. This may include driving to the burn location to monitor burns, respond to complaints, or investigate illegal burns.
8. When in the field, be aware of current atmospheric conditions that may effect burning. Incoming storms, changes in temperature and humidity, wind speed and direction, cloud type, visibility conditions, and affects of the surrounding terrain.
9. Record field conditions and observations.
10. If meteorological conditions in the field differ from those forecasted, immediately contact the Regional Office Analyst for direction. If conditions deteriorate, the **Seasonal Burn Coordinator has the authority** to require the burn extinguished or to require additional fuel is withheld such that the fire burns down.
11. Remain in contact with growers throughout the day either by cell phone or in person. Acreage of burn may be increased or decreased during the burn day, depending on improving or deteriorating conditions. The Smoke Management Analyst, in agreement with the regional office analyst, has the authority to increase acreage. If acreage is increased, the Seasonal Burn Coordinator will be contacted with the necessary information.
12. When all approved burns have been completed, update logs and databases as needed.

# APPENDIX C. Forecast Tools and Web Sites

## Meteorological Forecast

There are a number of forecast models and tools that are used regularly by smoke managers in the Northwest. Burn decisions should not be based on any one model. Rather, the output from a number of sources should be reviewed with a goal of determining where there is the most agreement.

## National Weather Service

**http://nimbo.wrh.noaa.gov** – The National Weather Service provides local weather forecasts, fire weather forecasts, satellite imagery, air quality advisories, fuel moisture maps, soundings and access to many local weather stations.

- **Forecast Discussion**
  - http://www.arl.noaa.gov/readbin/state.pl?product=discuss&state=id
  - http://iwin.nws.noaa.gov/iwin/id/discussion.html
- **Model Diagnostic Discussion**
  - http://www.hpc.ncep.noaa.gov/discussions/pmdhmd.html
- **500mb Chart (MRF)**
  - http://www.weather.unisys.com/mrf/9panel/mrf_500p_9panel.html
  - http://www.atmos.washington.edu/mm5rt/
- **850mb Chart (ETA)**
  - http://www.weather.unisys.com/eta/4panel/eta_850_4panel.html
  - http://www.atmos.washington.edu/mm5rt/
- **Skew-T Diagram**
  - http://rucsoundings.noaa.gov/ --- use RAOB and city airport designator
  - http://www.emc.ncep.noaa.gov/mmb/etasoundings/snding.html
  - http://www.arl.noaa.gov/ready/cmet.html
  - http://www.fs.fed.us/pnw/airfire/sf/
- **Meteograms**
  - http://www.emc.ncep.noaa.gov/mmb/meteograms/meteo_nw.html
  - http://www.atmos.washington.edu/mm5rt/meteograms.cgi?Eta+2003102312
  - http://www.arl.noaa.gov/ready/cmet.html
- **Time-Height Sequences**
  - http://www.emc.ncep.noaa.gov/mmb/meteograms/meteo_nw.html
  - http://www.fs.fed.us/pnw/airfire/sf/
- **RADAR**
  - http://weather.noaa.gov/radar/mosaic/DS.p19r0/ar.us.conus.shtml

- http://weather.gov/radar_tab.html

- **Satellite Imagery**
  - http://www.goes.noaa.gov/
  - http://weather.gov/sat_tab.html
- **Meteorological Calculators**
  - http://www.crh.noaa.gov/lsx/calc.php
  - http://www.arl.noaa.gov/ready/tools.html
- **Current Observations**
  - http://www.wrh.noaa.gov/boi/current.php

## MM5

**http://www.atmos.washington.edu/mm5rt/** - MM5 produces 72-hour forecasts twice-daily using the mesoscale weather prediction model. MM5 can be used to evaluate ventilation index, transport and surface winds (925mb, 850mb, 700mb, 500mb and 10m), planetary boundary layer, mixing height depth, precipitation, and soundings.

## Air Quality Models

**BlueSkyRAINS** **http://www.blueskyrains.org/** - BlueSkyRAINS links computer models of fire, weather, smoke dispersion, and fuel consumption and emissions into a model. BlueSkyRAINS can be used to evaluate ventilation index, mixing height, wind speed and direction, smoke trajectories, proposed prescribed burn locations, and wildfires.

**AIRPACT** **http://lar.wsu.edu/airpact-3/** - AIRPACT is a modeling system that forecasts hourly surface layer ambient concentrations for many pollutants. It uses daily meteorological forecasts (MM5) and a dispersion model (CMAQ) to estimate ambient concentrations from all emission sources. Of particular interest are the 1-hour, 8-hour, and 24-hour $PM_{2.5}$ ambient concentrations; and the 1-hour and 8-hour $O_3$ concentrations.

**ClearSky** **http://www.clearsky.wsu.edu** – ClearSky is a modeling system that forecasts hourly average surface layer ambient concentrations of $PM_{2.5}$ expected to result from user-defined scenarios of agricultural field burning. It uses daily meteorological forecasts (MM5) and a dispersion model (CALPUFF) to estimate ambient concentrations from one or more potential agricultural field burns. If potential burn locations for the following day are known, a 'most probable scenario' should be entered into ClearSky.

# APPENDIX D. Wild Land Fires and Prescribed Fires Tools

Review wildland fire or prescribed burn information using a combination of the following resources and/or websites.

- **Local fire safety agencies –** such as the Idaho Department of Lands, United States Forest Service, Bureau of Land Management, and local and county fire dispatches about local conditions on an as needed basis.
- **Grangeville Interagency Dispatch Center** http://www.fs.fed.us/r1/nezperce/gvc/index.htm
- **Eastern Idaho Interagency Fire Center**
- http://www.fs.fed.us/r4/caribou-targhee/eiifc/current_fires.htm
- **National Interagency Fire Center** http://www.nifc.gov
- **United States Forest Service MODIS Active Fire Mapping Program** http://activefiremaps.fs.fed.us
- **Grangeville Interagency Dispatch Center** **http://www.fs.fed.us/r1/nezperce/gvc/index.htm** - The Grangeville Interagency Dispatch Center operates out of the Nez Perce National Forest Supervisor's Office. It provides wildfire information, situation reports, fire weather forecasts, fire maps, area updates on air quality, and the latest news on the fire zone, among others.
- **National Interagency Fire Center** **http://www.nifc.gov** – NIFC is a national support center for wild land firefighting and disaster response. Review this website for information on the National Fire News Wild land Fire Update, wild land fire statistics, and Incident Management Situation Reports.
- **United States Forest Service MODIS Active Fire Mapping Program** **http://activefiremaps.fs.fed.us** – MODIS is a remote sensing application that illustrates fire location based on data provided by the National Interagency Fire Center. This website is useful for fire activity that has occurred in the last 24-hour period.
- **Montana/Idaho State Airshed Group** **http://www.smokemu.org** – The Montana/Idaho State Airshed Group coordinates efforts to manage smoke during wildfire and prescribed burning seasons. A map of the group's approved burns for each day should be printed and attached to the checklist. If AQ staff is in disagreement with the approval of these burns, the Smoke Monitoring Unit should be contacted.

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# APPENDIX E. Requirements for Enhanced Documentation

## Requirements for the Issuance of Yellow Sheets and Red Sheets

A yellow sheet is required if the 24 hour average $PM_{2.5}$ value equals or exceeds 16 $\mu g/m^3$ for the day prior to the burn call, or if the 2 hour average equals or exceeds 22 $g/m^3$ any time 6 hours prior to the time of the burn call.

Once a yellow sheet has been issued for a particular $PM_{2.5}$ sampler, if the 2 hour average for that sampler equals or exceeds 32 $\mu g/m^3$ any time in the 20 hours after the burn call, a RED sheet is required.

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## Yellow Sheet Documentation - Additional Documentation for Allowing Additional Agricultural Burning

Date:_____ Monitor:_____

Air Quality Readings:_____ at _____ __/__/__

**Details Regarding Allowed Burning:**

| Date | Time(s) | Location | Size |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Rationale / explanation of the determination that the additional burning is not expected to result in a further, significant reduction of air quality:

_____
_____
_____
_____
_____

Name:_____ Signature:_____

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## Red Sheet Documentation - Follow-Up Evaluation

Date:_____ Monitor:_____

Prior Readings:_____ at _____ __/__/__

Follow-up Readings:_____ at _____ __/__/__

**Details Regarding Actual Burning:**

| Date | Time(s) | Location | Size |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

**Method / Process of evaluation (include information reviewed, sources, etc.):**

_____
_____
_____

**Details regarding Dispersion and Meteorology:**

_____
_____
_____

**Special and/or unanticipated events, circumstances, situation:**

_____
_____
_____

**Summary of Explanation:**

_____
_____
_____

**Refer for additional investigation: _____Yes _____No _____Potentially**

**(Explanation: _____)**

**Name: _____ Signature: _____**

**Attachments: (list)**

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# APPENDIX F. State Implementation Plan Requirements for Burn Decision Criteria

This Appendix contains the specific information that was included in the SIP. This information will be used in conjunction with the rest of the information in this operating guide. Some of the information included in this Appendix is also discussed elsewhere in this guide. The purpose of this appendix is to ensure that DEQ captures all the requirements from the SIP.

## Meteorological Data

The goal is to assure good to excellent ventilation (smoke rises away from the ground) and good to excellent dispersion (smoke goes into the transport winds and moves out of the area). Aspects of the meteorological data that will be evaluated include:

Ventilation index. The ventilation index is a calculation based on the surface wind speed and the mixing height. The ventilation index for the burn area should be 'marginal' to 'excellent' throughout the duration of the approved burn(s).

- Burns should be grouped by areas of best ventilation.
- Burning under poor ventilation should not be conducted.
- Burning under marginal ventilation can be successfully completed if the other prescription criteria are met and should only be approved on a case-by-case or as-needed basis.
- Ventilation is established both by forecasted characteristics, as well as observed in-the-field smoke behavior and cloud formation.

Cloud cover should be "mostly sunny" to "partly cloudy." Uplifting, billowy clouds (fair weather cumulus) show the most unstable conditions (best ventilation & dispersion).

- Clear, bright blue skies are often indicative of high pressure weather systems. Before burning under clear skies, all other prescription criteria should be met.
- Burning under low-lying, solid cloud cover should be avoided if the mixing height is at or near the same elevation as the cloud layer. If the solid cloud cover is at a higher elevation, burning can be successfully accomplished if other prescription parameters are met.

Surface wind speeds should be in the 3-8 mph range or at a speed sufficient to carry the fire.

- Winds speeds at less than 3 mph can often make fire spread unpredictable. Wind that is too light and variable can create poor dispersion conditions.
- When burning within 3 miles of an institution with a sensitive population, wind speeds should be no greater than 12 mph, and, generally, the wind speed should be within 3-8 mph, which is the optimum range.
- Additionally, burning when surface winds are greater than 12 mph should be done with extreme caution. Too strong of surface winds can inhibit plume rise, pushing smoke along the surface. Additionally, strong surface winds can also make control of the fire difficult.

Surface wind direction can vary, depending upon the location of the burn(s).

- Burn to keep smoke away from sensitive receptors (e.g. schools, homes, population centers, hospitals, retirement centers, highways, airports, and valleys). When conditions are such that winds and poor dispersion would direct, or are predicted to direct (during the proposed burn period), smoke toward those receptors, burning should not be conducted.
- Take caution if the surface wind direction is forecasted to shift at some point during the burn day.

Transport wind speed should be 7 – 20 mph for best dispersion.

- Be cautious of burning when transport wind speeds exceed 20 mph. Too strong transport winds may produce a curling effect causing smoke to return to the surface.

Transport wind direction is dependent upon the location of the burn(s).

- Burn to keep smoke away from institutions with sensitive populations (e.g. schools, homes, population centers, hospitals, retirement centers, highways, airports, and valleys). When conditions are such that winds and poor dispersion would direct smoke toward those receptors, burning should not be conducted.
- Take caution if the transport wind direction is forecasted to shift at some point during the burn day. A shift in direction can result in an impact to institutions with sensitive populations and/or increase fire risk.

Mixing heights should be at least 1,000 feet above ground level.

- Mixing heights may vary throughout the airshed based on changes in elevation and other surface features, such as water.

Relative Humidity (RH) should be considered relative to fire and fuel type, moisture of any potential fuels surrounding or adjacent to the burn, and ventilation conditions.

- Lower RH values below 25% can be considered for crop residue burns. However, because lower RH values can make it difficult to control a fire, any potential surrounding fuels must be considered to avoid the risk of escaped fire. This case is especially true for forestry prescribed burns.
- For bluegrass residue burns, RH values over 30% tend to inhibit plume rise and smoke dispersal, so ventilation conditions should be especially considered.
- High RH values (above 60%) can inhibit smoke dispersal and a fire may leave unburned islands or may not burn hot enough to accomplish the desired result.
- The response to changes in relative humidity is much more rapid in fine dead fuel suspended above the ground because these fuels are not in contact with the damp lower layer and are more exposed to the sun and wind.

Radiation Inversions. Under optimum conditions, the burn window may be narrow due to radiation inversions.

- Burning should not be permitted before the inversion has mixed out unless transport conditions after breakup would not protect population centers.

- A sufficient amount of time should be allowed at the end of the burn day for any residual smoke to leave the area before a radiation inversion returns.

### Specific Attributes of the Burn Management Areas

Idaho has diverse terrain, topography, climate, soils and crops. To better address this diversity, DEQ has developed Burn Management Areas (BMA) that divide the state into more manageable parts. Within the BMAs, DEQ may develop specific prescriptions designed to maximize smoke dispersion and to minimize air quality impacts.

Some examples of prescriptions that may apply to all, or part, of a BMA are:

- Burning Near/Along Canyon Rims should be done when both transport and surface winds are blowing away from the canyon.
    - Ensure adequate plume rise will occur. In some cases a test burn may be necessary. Smoke that travels over the canyon while the temperatures in the canyon are relatively cooler than those elsewhere, will drop.
    - For fire safety reasons, burns should be conducted before surface wind speed increases (typically by 12:00PM). Avoid burning if 'whirlwinds' are visible.
- Over larger bodies of water, the atmosphere will typically be cooler and more stable. This can cause 'lake-breezes' in the afternoon that will pull smoke downward - winds at the surface blow from the lake to shore, which causes air above the lake to sink downward. Even in the absence of a true lake-breeze, the interaction between lake-generated winds and prevailing winds is complex and can cause variable conditions that can change quickly. Knowledge of the expected prevailing wind direction and strength is important. It is also important to know the direction of transport winds aloft. They may transport smoke over the lake. Surface and transport winds can be from vastly different directions. A good guide would be to burn downwind of major lakes (so that the smoke never gets a chance to blow over the lake).
- Favorable Winds. Certain areas have fairly predictable daily wind shifts. In such areas, burns should be timed to match favorable dispersion characteristics.

### Visibility

Visibility conditions should be considered when deciding whether or not to approve burning. When deciding to allow burning on a given day, if visibility is less than 10 miles and is expected to remain so throughout that day, a no burn decision will be made.

### Individual Fields/Institutions with Sensitive Populations

DEQ will consider the following factors in developing specific prescriptions and burn approvals.

- Burn location is identified on the permit at the township/range/section level (one square mile).
- Elevation and aspect are also considered. Due to microclimatic variations in wind speed, direction, lift and dispersion, burn location information is very important.

- Proximity to Institutions with Sensitive Populations. The proximity of the burn to institutions with sensitive populations, including public schools while in session; hospitals; residential health care facilities for children, the elderly or infirm; and other institutions with sensitive populations as approved by the Department. The Department shall not authorize a burn if conditions are such that institutions with sensitive populations will be adversely impacted or when the plume is predicted to impact such institutions.
- Proximity to Public Roadways. Proximity to public roadways.
- Proximity to Airports. Proximity to airports
- Proximity of Other Burns. The proximity of other burns and other potential emission sources within the area to be affected by the proposed burn.
- Size of the burn includes the area (acres or feet) of the burn as well as the height of the burn if the burn is a pile.
- Burning method refers to the lighting method such as match/lighter, propane torch, or diesel burners, as well as the pattern of lighting. Generally, the hotter the fire, the less smoke it produces, and the better the smoke is pushed upward for dispersion.
    - If a field is lit slowly section by section and/or is lit from the top of a slope downward, the burn can take longer, not burn as hot, and may produce more smoke than burning a field more effectively.
    - A typical, more effective burn begins with lighting a backfire along the downwind perimeter of a burn. A backfire moves slowly and with relatively low flames because it burns into the wind. When a backfired portion of the burn is safe, flank fires are generally lit beginning at the backfire along burn perimeters parallel with the wind. Flank fires have moderate flame heights and speed because they move perpendicular to the wind. When the back and flank portions of the fire are safe, a head fire is typically lit to quickly consume the remaining fuel. A head fire moves relatively fast with longer flames because it burns with the wind. Usually, fires that burn uphill act as head fires and those that burn downhill act as backfires, regardless of wind direction.
- Fuel type affects smoke generation and dispersion. Generally, the more dense the fuel, the more smoke it produces when it burns. For example, fuel density can change with crop type and variety (e.g. generally, wheat stubble is less dense than bluegrass stubble, and certain wheat or bluegrass varieties can be more dense than others).
- Fuel loading/expected emissions. Fuel loading is a function of fuel type, acreage of the burn, density of material remaining in the field, and burn type. Generally, the greater the fuel loading, the greater the expected emissions and the potential for smoke.
- Fuel moisture is dependent upon fuel type and relative humidity. In general, fuel moisture should be as dry as possible throughout the residue layer to promote plume rise.
- Fuel moisture influences smoke quantity and plume rise. In general, the greater the fuel moisture, the more smoke and poorer plume rise.
- Fuel moisture should be initially assessed independently of RH.

- Relative Humidity and temperature controls fuel moisture content up to about 32 percent. Liquid moisture such as rain or dew must contact a fuel for moisture content to rise above 32% and the increase depends upon the duration as well as the amount of precipitation.
- The moisture content for fine or dead fuel, such as pine needles and dried grasses, responds rapidly to changes in relative humidity.
- There is a lag time involved for fuel moisture content to reach equilibrium with the RH of the surrounding atmosphere.
- Previous drying and wetting of the fuel will influence fuel moisture.